PATENT ABSTRACTS OF JAPAN

(11)Publication number : 08-066989

(43)Date of publication of application : 12.03.1996

(51)Int.Cl. B32B 15/08
B29C 43/18
B32B 3/24
B32B 5/02
B32B 27/42
// B29K105:08
B29K105:22
B29L 9:00

(21)Application number : 07-147587

(22)Date of filing : 14.06.1995

(71)Applicant : KOBE STEEL LTD

(72)Inventor : SUGINO MORIHIKO
TANAKA KEIKO
NAKAGAWA TOMOKAZU

(30)Priority

Priority number : 06143325 Priority date : 24.06.1994 Priority country : JP

(54) IRREGULAR SHAPE FIBER REINFORCED PLASTIC AND ITS MANUFACTURE

(57)Abstract:

PURPOSE: To provide superior heat conductivity without lowering mechanical properties and improve the reduction of local temperature rise and outer appearance of shape by disposing integrally metal sheets by means of press molding on a surface layer of irregular shape fiber reinforced plastic in which carbon fibers of specified fiber length are distributed planarly and irregularly in a heat curing resin matrix.

CONSTITUTION: Carbon fibers of 10-100mm fiber length are distributed planarly and irregularly as a reinforcing material in a heat curing resin matrix to form an irregular shape CFRP, and metal sheets are disposed integrally on a surface layer by press molding. The fiber length of carbon fibers is in the range of 10-100mm when the length is less than 10mm, and the interlocking of fibers one another is reduced and sites containing fibers of small amount only are formed partially to lower the strength and elasticity and make them insufficient, while when the length is beyond 100mm, the carbon fibers are turned into the curl shape to lower the strength and elasticity and make them insufficient. The fiber length of carbon fibers is

desirably in the range of 20-30mm, by which the high strength and elasticity can be provided securely.

LEGAL STATUS

[Date of request for examination] 13.02.2002

[Date of sending the examiner's decision of rejection] 03.08.2004

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

CLAIMS

[Claim(s)]

[Claim 1] It considers as reinforcement into the matrix which consists of thermosetting resin, and is fiber length:10-100mm. Anomaly-like fiber reinforced plastics which carbon fibers are the anomaly-like fiber reinforced plastics distributed that it is two-dimensional and in irregular, and are characterized by having allotted the metallic thin plate to one by press forming at the surface layer.

[Claim 2] The thickness of said metallic thin plate Anomaly-like fiber reinforced plastics according to claim 1 which are 0.5mm or less.

[Claim 3] Anomaly-like fiber reinforced plastics according to claim 1 or 2 which said metallic thin plate becomes from aluminum, aluminum alloy, Cu, or Cu alloy.

[Claim 4] Anomaly-like fiber reinforced plastics of the area which said metallic thin plate has a slit-like opening, and is occupied to the metallic thin plate of the opening according to claim 1, 2, or 3 a certain voidage of whose it comes out comparatively and is 50% or less.

[Claim 5] said thermosetting resin -- phenol resin: -- the anomaly-like fiber reinforced plastics according to claim 1, 2, 3, or 4 which are thermosetting resin containing more than 30wt%.

[Claim 6] Anomaly-like fiber reinforced plastics according to claim 1, 2, 3, 4, or 5 whose fiber length of said carbon fiber is 20-30mm.

[Claim 7] Anomaly-like fiber reinforced plastics according to claim 1, 2, 3, 4, 5, or 6 whose rate of a volume ratio to the matrix of said carbon fiber is 15 - 35%.

[Claim 8] Anomaly-like fiber reinforced plastics according to claim 1, 2, 3, 4, 5, 6, or 7 in which are the one Plastic solids of the variant configuration which has the monotonous section and the convex variant configuration section, and the carbon fiber in the root of this variant configuration section is carrying out orientation in the direction which connects the monotonous section and the variant configuration section.

[Claim 9] Tensile strength: 2450MPa Sink in and dry thermosetting resin to the nonwoven fabric which consists of the above carbon fiber, and prepreg is obtained. The metallic thin plate which applied resin to the front face of the side which contacts said prepreg and this prepreg in the die which has a variant cavity is arranged. Planar pressure : while carrying out heating pressurization by 9.8 or more MPas and temperature:140 - 220 **, making a carbon fiber flow within a cavity with the thermosetting resin in prepreg and fabricating to anomaly-like fiber reinforced plastics The manufacture approach of the anomaly-like fiber reinforced plastics characterized by allotting a metallic thin plate at one to the surface layer.

[Claim 10] The manufacture approach of anomaly-like fiber reinforced plastics according to claim 9 that the resin applied to said metallic thin plate is an epoxy resin.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] This invention contains a carbon fiber as reinforcement about anomaly-like fiber reinforced plastics and its manufacture approach in the matrix which becomes a detail from thermosetting resin, about the anomaly-like fiber reinforced plastics which have a metallic thin plate in a surface layer, and its manufacture approach, especially, is used for housing material, such as electronic equipment, such as a CD player, a headphone stereo cassette tape recorder, and a notebook sized personal computer, and an electrical machinery and apparatus, and relates to suitable anomaly-like fiber reinforced plastics and its manufacture approach.

[0002]

[Description of the Prior Art] Although the metaled pressed part was used as housing material, such as electronic equipment and an electrical machinery and apparatus, from viewpoints, such as workability and lightweight-izing, plastics-ization of housing material is progressing and anomaly-like fiber reinforced plastics are being used as housing material of these devices in recent years. Especially, in portable electronic devices, such as a notebook sized personal computer, small lightweight-ization is demanded strongly and application of the anomaly-like fiber reinforced plastics to housing material is put in practical use as part of that.

[0003] As these anomaly-like fiber reinforced plastics and its manufacture approach, what was indicated by JP,5-58371,B is well-known. the inside of the matrix to which the anomaly-like fiber reinforced plastics (henceforth -- the former -- the shape of an anomaly -- it is called CFRP-1) of a publication become this official report from thermosetting resin -- as reinforcement -- fiber length:10-100mm The carbon fiber is distributed that it is two-dimensional and in irregular, and it is characterized by the thickness of the monotonous section being 1mm or less. And such a configuration, especially fiber length: 10-100mm It is [that mechanical properties, such as tensile strength and an elastic modulus, are excellent with two-dimensional and irregular distribution of a carbon fiber, and] uniform.

[0004] The manufacture approach of anomaly-like fiber reinforced plastics given in this official report Tensile strength : Sink in and dry thermosetting resin to the nonwoven fabric which consists of a carbon fiber more than 300 kgf/mm2 (:2942MPa), and prepreg is obtained. This prepreg is arranged in the die which has a variant predetermined cavity. Planar pressure: Heating pressurization is carried out above 100 kgf/cm2 (:9.8MPa), and a carbon fiber is made to flow within a cavity with the thermosetting resin in prepreg, and it is characterized by fabricating to anomaly-like fiber reinforced plastics. and by making a carbon fiber flow with such a configuration, especially thermosetting resin, a carbon fiber is distributed in a matrix at homogeneity, and the anomaly-like fiber reinforced plastics (henceforth -- the former -- the shape of an anomaly -- it is called CFRP-2) which mechanical characteristics, such as tensile strength and a modulus of elasticity, were uniform, and were excellent are obtained.

[0005]

[Problem(s) to be Solved by the Invention] It reaches anomaly-like CFRP-1 conventionally [said] and is 2. If it depends, since mechanical characteristics, such as tensile strength and a modulus of elasticity, are uniform and excellent like the above, if lightweight-ization of housing material, such as electronic equipment and an electrical machinery and apparatus, can be attained and it lengthens, lightweight-ization of the electronic equipment, electrical machinery and apparatus, etc. can be attained.

[0006] However, it will follow on miniaturization and high-capacity-izing of these electronic equipment, an electrical machinery and apparatus, etc. from now on. Since the calorific value from the electronic circuitry and electrical circuit (following, electronic circuitry), electronic parts, or an electrical part (following, electronic parts) increases remarkably and heat cannot escape easily, The device itself becomes an elevated temperature, and, as for dependability ****** of electronic parts, the dependability as a device falls, and the temperature of housing (case) rises locally with the heat from electronic parts. If the direct body is touched, failures, such as a low-temperature burn, may occur, and there is a possibility that the trouble of giving a user insecurity may arise. Therefore, conventionally, by the shape of an anomaly CFRP, miniaturization and high-capacity-izing of electronic equipment, an electrical machinery and apparatus, etc. are restricted, and there is a possibility of saying that sufficient miniaturization and high capacity-ization cannot be attained.

[0007] Moreover, conventionally, by the shape of an anomaly CFRP, the carbon fiber which exists near the front face and the front face can be seen with the naked eye, originates in the wave the appearance of a wave is not good and and a wave's is peculiar to a carbon fiber in the thing of the thin meat not more than thickness:1mm, boom hoisting is shown in a front face, and there is a trouble that shapeability and an appearance are not good.

[0008] This invention is made paying attention to such a situation. The purpose Without canceling the trouble which the shape of an anomaly CFRP has conventionally [above mentioned], and reducing the outstanding mechanical property Excel in thermal conductivity, and the local temperature rise by local heating is small, and heat tends to escape. Furthermore, even if who has only few front faces by the carbon fiber, and its appearance (a carbon fiber being unable to be seen with the naked eye) is good and they are the things of the thin meat not more than thickness:1mm, there is no boom hoisting in a front face, and shapeability and an appearance tend to offer good anomaly-like fiber reinforced plastics and its manufacture approach.

[0009]

[Means for Solving the Problem] In order to attain the above-mentioned purpose, the anomaly-like fiber reinforced plastics (it is henceforth called the shape of an anomaly CFRP) concerning this invention and its manufacture approach are considered as the following configurations. That is, the shape of an anomaly CFRP according to claim 1 is fiber length:10-100mm as reinforcement in the matrix which consists of thermosetting resin. A carbon fiber has the shape of an anomaly CFRP distributed that it is two-dimensional and in irregular, and it has the shape of an anomaly CFRP characterized by having allotted the metallic thin plate to one by press forming at the surface layer.

[0010] The thickness of said metallic thin plate the shape of an anomaly CFRP according to claim 2 It has the shape of an anomaly CFRP according to claim 1 which is 0.5mm or less. The shape of an anomaly CFRP according to claim 3 has the shape of an anomaly CFRP according to claim 1 or 2 which said metallic thin plate becomes from aluminum, aluminum alloy, Cu, or Cu alloy. The shape of an anomaly CFRP according to claim 4 has the shape of an anomaly CFRP of the area which said metallic thin plate has a slit-like opening, and is occupied to the metallic thin plate of the opening according to claim 1, 2, or 3 a certain voidage of whose it comes out comparatively and is 50% or less. The shape of an anomaly CFRP according to claim 5 has the shape of an anomaly CFRP according to claim 1, 2, 3, or 4 which is thermosetting resin with which said thermosetting resin contains more than phenol resin:30wt%. The shape of an anomaly CFRP according to claim 6 has the shape of an anomaly CFRP according to claim 1, 2, 3, 4, or 5 whose fiber length of said carbon fiber is 20-30mm. The shape of an anomaly CFRP according to claim 7 has the shape of an anomaly CFRP according to claim 1, 2, 3, 4, 5, or 6 whose rate of a volume ratio to the matrix of said carbon fiber is 15 - 35%. The shape of an anomaly CFRP according to claim 8 has the shape of an anomaly CFRP according to claim 1, 2, 3, 4, 5, 6, or 7 in which is the one Plastic solid of the variant configuration which has the monotonous section and the convex variant configuration section, and the carbon fiber in the root of this variant configuration section is carrying out orientation in the direction which connects the monotonous section and the variant configuration section.

[0011] The variant manufacture approach CFRP according to claim 9 Tensile strength: 2450MPa Sink in and dry thermosetting resin to the nonwoven fabric which consists of the above carbon fiber, and prepreg is obtained. The metallic thin plate which applied resin to the front face of the side which contacts said prepreg and this prepreg in the die which has a variant cavity is arranged. Planar pressure : while carrying out heating pressurization by 9.8 or more MPas and temperature:140 - 220 **, making a carbon fiber flow within a cavity with the thermosetting resin in prepreg and fabricating in the shape of [CFRP] an anomaly It is the variant manufacture approach CFRP characterized by allotting a metallic thin plate at one to the surface layer. The

variant manufacture approach CFRP according to claim 10 has the shape of an anomaly CFRP according to claim 9 whose resin applied to said metallic thin plate is an epoxy resin.
[0012]
[Function] The shape of an anomaly CFRP concerning this invention (anomaly-like fiber reinforced plastics) Like the above, it is fiber length:10-100mm as reinforcement in the matrix which consists of thermosetting resin. A carbon fiber has the shape of an anomaly CFRP distributed that it is two-dimensional and in irregular. Conventionally, thermal conductivity improves, the metallic thin plate is allotted to that surface layer by press forming at one, therefore it originates in this metallic thin plate, and heat becomes [the local temperature rise by local heating is small, and] easy to escape from the shape of an anomaly CFRP.
[0013] That is, conventionally, in the shape of an anomaly CFRP, it is that to which thermal conductivity is inferior in CFRP remarkably as compared with a metal (thermal conductivity is small), and when local heating is received, the heat cannot spread easily in the direction of a field of a CFRP plate, therefore the temperature of a local heating unit tends to rise, and a local temperature rise tends to become large. Moreover, although that heat makes propagation and the CFRP plate front face which reached a heat sinking plane in the direction of board thickness of the CFRP plate of a local heating unit and it escapes to the exterior, since the area of this heat sinking plane is the area and the abbreviation EQC of a local heating unit and is small, the heat release from this heat sinking plane is small, and, for that reason, heat cannot escape very easily.
[0014] On the other hand, in the shape of an anomaly CFRP concerning this invention, by having allotted the metallic thin plate like the above to the surface layer, when a metal is that in which thermal conductivity is remarkably excellent as compared with CFRP (thermal conductivity is large) and local heating is received, the heat tends to spread in the direction of a field of a metallic thin plate, therefore temperature of a local heating unit cannot rise easily, and a local temperature rise tends to become small. And the heat diffused in the direction of a field of this metallic thin plate escapes to the exterior at the anomaly-like CFRP section by making propagation and the CFRP plate front face which reached into a heat sinking plane. Since the area of this heat sinking plane is the surface area and the abbreviation EQC of a metallic thin plate and is large at this time, the heat release from this heat sinking plane is large, therefore heat becomes easy to escape.
[0015] Moreover, in the shape of an anomaly CFRP concerning this invention, since the metallic thin plate is allotted to the surface layer by press forming like the above at one, even if it is the thing of the thin meat not more than thickness:1mm, there is no boom hoisting in a front face, and shapeability and an appearance are good for it. That is, since a wave peculiar to a carbon fiber arises in the shape of an anomaly CFRP according to the difference of contraction at the time of shaping with the thermosetting resin of a matrix, and a carbon fiber conventionally, boom hoisting is caused on a front face, but since appearance covering is carried out by the metallic thin plate of a surface layer in the shape of an anomaly CFRP concerning this invention, surface relief will not happen and shapeability and an appearance will become good.
[0016] Furthermore, since CFRP stops being exposed to an appearance with the metallic thin plate of the above-mentioned surface layer, a carbon fiber cannot be seen with the naked eye, and an appearance is good.
[0017] the inside of the matrix which the CFRP section which is the base material with which the above-mentioned metallic thin plate is allotted to coincidence in the shape of an anomaly CFRP concerning

this invention becomes from thermosetting resin -- as reinforcement -- fiber length:10-100mm CFRP over which the carbon fiber was distributed that it is two-dimensional and in irregular -- becoming -- this CFRP -- the former -- the shape of an anomaly -- since it is the same as that of CFRP-1 -- the former -- the shape of an anomaly -- it has the mechanical property which was excellent like CFRP-1. Moreover, since the above-mentioned metallic thin plate is thin, the starting outstanding mechanical property is not spoiled (it is made to fall).

[0018] Therefore, while the shape of an anomaly CFRP concerning this invention has the mechanical property which was excellent conventionally like the shape of an anomaly CFRP, compared with the shape of an anomaly CFRP, it excels in thermal conductivity, and the local temperature rise by local heating is small, and heat tends to escape, even if a carbon fiber cannot be seen with the naked eye, and an appearance is good and is the thing of the thin meat not more than thickness:1mm further, there is no boom hoisting in a front face, and it is conventionally good. [of shapeability and an appearance]

[0019] here -- the fiber length of a carbon fiber -- 10-100mm ** -- since a debt of carbon fibers decreases and a part with few contents of a carbon fiber exists partially, less than 10mm of carry out falls [reinforcement and an elastic modulus] and is insufficient -- becoming -- on the other hand -- 100mm It is because a carbon fiber serves as a letter of curl, so reinforcement and an elastic modulus fall and it becomes inadequate in **. In addition, if it is desirable to make it 20-30mm as for the fiber length of a carbon fiber and it does so from this point, advanced reinforcement and an advanced elastic modulus can be secured certainly (the shape of an anomaly (CFRP) according to claim 6).

[0020] As said metallic thin plate, the thing with the point of lightweight-izing to small and specific gravity which has good workability is desirable, and what consists of this point to aluminum, aluminum alloy, Cu, or Cu alloy is desirable (the shape of an anomaly (CFRP) according to claim 3). Surface treatment, such as alumite processing, plating, and paint, may be performed to these metallic-thin-plates front face.

[0021] It is desirable to be referred to as 0.5 or less mm as thickness of said metallic thin plate (the shape of an anomaly (CFRP) according to claim 2). thickness of a metallic thin plate if it 0.5mm super-**, since the thickness of the CFRP section becomes thin relatively, it causes a strong fall and the fall of lightweight nature and is not desirable -- it is because it can have the reinforcement and lightweight nature of a high level in 0.5 or less mm. In addition, in addition to forming a metallic thin plate in a CFRP surface layer like the above, a metallic thin plate can be formed also in the interior of CFRP, a moldability falls in that case, but a heat dissipation property improves further.

[0022] Things are [said metallic thin plate having a slit-like opening, and the area occupied to the metallic thin plate of the opening coming out comparatively, and making it a certain voidage be 50% or less] desirable (the shape of an anomaly (CFRP) according to claim 4). It is because generating of the curvature by difference of the coefficient of linear expansion of a metallic thin plate and the CFRP section can be controlled if it does in this way. Namely, although it changes with a metaled class and classes of CFRP usually, since coefficient of linear expansion is comparatively sharply different, when the metallic thin plate does not have the opening, a metal and CFRP Curvature may occur in mold goods also with the heat which the amount of contraction of the metallic thin plate and the CFRP section in the cooling process after heating in the case of manufacture (shaping) may be different, consequently curvature may generate in the thing after manufacture (mold goods), and is received in case it is mold-goods use. On the other hand,

although coefficient of linear expansion is different, the amount of contraction of the metallic thin plate and the CFRP section in the cooling process after heating in the case of manufacture (shaping) is seldom different, a metal and CFRP become equivalent, or are approximated, consequently when the metallic thin plate has the slit-like opening, even if it is hard coming to generate the curvature like the above and it occurs, they can be extremely limited to the curvature of a minute amount. At this time, extent of curvature can be made small so that voidage is large, but since it is in the inclination for a heat dissipation property to become little by little low in connection with it and a heat dissipation property falls comparatively greatly in 50% ** of voidage, voidage is good to make it to 50% or less. Moreover, since the same effect as the above-mentioned voidage is done to a heat dissipation property also about the gross area of an opening and a heat dissipation property falls comparatively greatly in gross area of 500mm 2 ** of an opening, it is good to carry out to two or less [500mm].

[0023] As said thermosetting resin, although there are phenol resin, an epoxy resin, polyimide resin, and such mixture, for example, it is desirable to consider as the thermosetting resin which contains more than phenol resin:30wt% especially (the shape of an anomaly (CFRP) according to claim 5). As for the shape of an anomaly CFRP, it is desirable to have the mechanical physical properties more than Izod-impact-value:98 J/m (: 10 kgfcm/cm2), and to excel in fire retardancy more than flexural strength:147MPa and more than bending elastic-modulus:12 GPa, and that is because these properties can be fulfilled.

[0024] It is desirable to make the rate of a volume ratio to the matrix of said carbon fiber 15 - 35%. If it does so, advanced reinforcement and an advanced elastic modulus can be secured certainly (the shape of an anomaly (CFRP) according to claim 7). If this rate of a volume ratio is made less than 15%, when reinforcement and an elastic modulus fall and super-** 35%, it is in the inclination for the resin of a matrix and the part which does not get used to arise and for reinforcement to fall.

[0025] When the shape of an anomaly CFRP concerning this invention has the monotonous section and the convex variant configuration section, it is desirable for the carbon fiber in the root of this variant configuration section to carry out orientation in the direction which connects the monotonous section and the variant configuration section (the shape of an anomaly (CFRP) according to claim 8). It is because this variant configuration section will be excellent in reinforcement and a difference on the strength with the monotonous section will become small, if it does so.

[0026] The variant manufacture approach CFRP concerning this invention is tensile strength:2450MPa like the above-mentioned. Sink in and dry thermosetting resin to the nonwoven fabric which consists of the above carbon fiber, and prepreg is obtained. The metallic thin plate which applied resin to the front face of the side which contacts said prepreg and this prepreg in the die which has a variant cavity is arranged. Planar pressure: While carrying out heating pressurization by 9.8 or more MPas and temperature:140 - 220 **, making a carbon fiber flow within a cavity with the thermosetting resin in prepreg and fabricating in the shape of [CFRP] an anomaly, he is trying to allot a metallic thin plate at one to the surface layer. therefore, the former -- the shape of an anomaly -- it has the shape of an anomaly CFRP which the carbon fiber was distributed in the matrix more than it like the case of CFRP-2 at homogeneity, and was excellent in mechanical properties, such as tensile strength and an elastic modulus, and was excellent in the homogeneity, and the shape of an anomaly CFRP which comes to allot a metallic thin plate to coincidence at a surface layer can be manufactured. therefore, the former -- the shape of an anomaly, while excelling in a

mechanical property more than it like the case of CFRP-2 and excelling in the homogeneity Originate in the metallic thin plate of the above-mentioned surface layer, and excel in thermal conductivity and the local temperature rise by local heating is conventionally smaller than the shape of an anomaly CFRP. Moreover, heat tends to escape, further, a carbon fiber cannot be seen with the naked eye, even if an appearance is good and is the thing of the thin meat not more than thickness:1mm, there is no boom hoisting in a front face, and the shape of an anomaly CFRP with sufficient shapeability and a sufficient appearance is acquired.

[0027] Here, they are 2450MPa(s) about the tensile strength of a carbon fiber. It is 49MPa(s) which are being considered as the above about variant tensile strength CFRP. It is for making it sufficiently high above. He is trying to apply resin to the front face (metallic-thin-plate front face) of the side which faces arranging prepreg and a metallic thin plate in a die, and contacts the prepreg of a metallic thin plate for raising the adhesion of the variant metallic thin plate CFRP after shaping, and CFRP of a base material, and considering as sufficient thing.

[0028] Moulding pressure in the case of shaping is set to 9.8 or more MPas by planar pressure because it becomes difficult for a carbon fiber to flow with thermosetting resin, the homogeneity of carbon fiber distribution in a matrix will fall and a mechanical property will turn into heterogeneity, if it is made less than 9.8 MPas. Moreover, if it comes to need for the setting time 10 minutes or more when it makes to make molding temperature into 140 - 220 ** under into 140 **, and the necessary setting time becomes long too much and it lengthens, the productivity of mold goods becomes low, and it becomes inadequate, and is [220 ** super-] because the setting time will become short too much if it **, therefore shaping (** form) becomes difficult.

[0029] As resin applied to said metallic thin plate, it is desirable to use an epoxy resin (the variant manufacture approach CFRP according to claim 10). It is because the adhesion of a metallic thin plate and CFRP of a base material can be raised more if it does so. Moreover, if the laminating of the prepreg arranged with a metallic thin plate is carried out, and it is arranged and is fabricated, the directivity of a carbon fiber is eased and it can make reinforcement of mold goods homogeneity more.

[0030]

[Example]

(Example 1) First, it sank in, stoving of the phenol resin (a kind of thermosetting resin) was carried out to the nonwoven fabric which consists of tensile strength:2942MPa and a fiber length:25mm carbon fiber for 10 minutes by 120 ** with the dryer, and prepreg (thickness: 1.0mm) was obtained. Thickness it is thin from pure aluminum on the other hand: The epoxy resin was applied to the top face (field of the side in contact with the after-mentioned prepreg 2) of a 0.3mm metallic thin plate. Next, while closing the punch 1, pressurizing by moulding pressure (planar pressure):39MPa and the temperature:150 degree C process condition and fabricating in the shape of [CFRP] an anomaly as shown in drawing 2 after having arranged said metallic thin plate 3 in female mold 4, carrying out the five-sheet laminating of said prepreg 2 and having arranged it on this, as shown in drawing 1 , the metallic thin plate was allotted to that surface layer at one. And the shape 5 of an anomaly CFRP concerning the example 1 which has the **** configuration shown in drawing 3 was acquired. In addition, thickness of this variant monotonous section CFRP 5 (sum total thickness of a metallic thin plate and the CFRP section) It is 0.9mm. The rate of the volume of the carbon fiber to the resin of the matrix of CFRP is 25%. In drawing 3 , 6 shows the boss section.

[0031] After performing clear paint and conducting a visual inspection about the shape 5 of an anomaly CFRP concerning this example 1, the local heat test was performed. Moreover, the test piece for bend test and the test piece for Izod impact test were extracted, and the bending test and the impact test were performed. Here, when the shape 5 of an anomaly CFRP was used as housing, the local heat test simulated the condition of being locally heated by the heat from electronic parts, heated it locally, and it was performed by measuring the temperature of the variant front face CFRP 5 at that time (the near field and the field of the opposite side which are heated). Consequently, a carbon fiber was not visible to a front face with the naked eye, the appearance was good, there was no boom hoisting in a front face, and shapeability and an appearance were still better for it. Izod impact value had the mechanical property in which 16GPa(s) and flexural strength are 246MPa(s), and 291 J/m and a bending elastic modulus excelled [flexural strength] like the example 1 of the following comparison. The highest attainment temperature of the variant front face CFRP 5 by the local heat test was 60 degrees C, and was remarkably low as compared with the case of the example 1 of the following comparison.

[0032] For the comparison, the shape of an anomaly CFRP which fabricates on the same conditions as the above-mentioned example 1 by the same approach using the same prepreg as the above-mentioned example 1, without arranging a metallic thin plate 3, and starts the example 1 of a comparison was acquired, and the same inspection as the above-mentioned example 1 and a trial were performed about this CFRP. Consequently, a carbon fiber is visually visible to a front face, and surface relief (wave) is private seal ** further. In addition, this wave was more remarkable than paint before the clear paint back. Izod impact value was [15GPa(s) and the flexural strength of 250 J/m and a bending elastic modulus] 240MPa(s). The highest attainment temperature of the front face by the local heat test was 95 degrees C, and was very high.

[0033] (Example 2) In order to obtain the fundamental data about the local temperature rise depressor effect by local heating at the time of using Cu sheet metal as a variant metallic thin plate CFRP concerning this invention, as shown in drawing 4 , the CFRP plate 7 (namely, compound plate which allotted the metallic thin plate 8 made from pure Cu to the surface layer of the CFRP plate 7) which allotted the metallic thin plate 8 made from pure Cu to the surface layer was fabricated by press forming, and the local heat test was performed about this. Here, the fiber length:30mm thing was used as a carbon fiber of reinforcement, using phenol resin as resin of the matrix of CFRP. the dimension of a compound plate -- 0.83mm in width of face of 90mm, die length of 140mm, and the total thickness -- it is -- the CFRP Itabe's 7 thickness -- the thickness of 0.63mm and the metallic thin plate 8 made from pure Cu -- 0.2mm it is . A local heat test makes the heating element 9 of the square plate configuration (48mm of side length) of 4.81W the source of heating, as shown in drawing 4 . It places through the spacer made of C system resin on a compound plate (on the metallic thin plate 8 made from pure Cu). After, sticking CC (copper and constantan) thermocouple on the thermometry point 10 of the compound plate bottom (front face of the CFRP plate 7) on the other hand and covering these with a carton (not shown), while energizing to the heating element 9 and heating the compound plate, it carried out by measuring the temperature in the thermometry point 10.

[0034] The maximum temperature in the thermometry point 10 (namely, front face by the side of that has a heating element 9 in a compound plate and opposite) 1 above-mentioned hour after heating initiation was 64.2 degrees C. Moreover, in the case of Mg alloy plate, in the case of the plate of 62.0 degrees C and a CFRP simple substance, when it replaced with the above-mentioned compound plate and the same local

heat test was performed by the same approach as the above using Mg alloy plate of the same dimension as the above-mentioned compound plate, or the plate (it consists only of a CFRP plate) of a CFRP simple substance for the comparison, the maximum temperature in the thermometry point 10 1 hour after heating initiation was 95.7 degrees C. It turns out that a local rise maximum temperature will become it of Mg alloy plate, and an EQC from these things with a CFRP simple substance if the metallic thin plate made from pure Cu is allotted and compound-ized to the surface layer of CFRP although a local rise maximum temperature is high 30 degrees C or more compared with Mg alloy plate, and a heat dissipation property is sharply improved compared with a CFRP simple substance.

[0035] (Example 3) The lower housing of the notebook sized personal computer which consists of the shape of an anomaly CFRP concerning this invention was made. The important section of this lower housing is shown in drawing 5 . Here, the fiber length:30mm thing was used as a carbon fiber of reinforcement, using phenol resin as resin of the matrix of CFRPs 12 and 13. As a metallic thin plate 15 of a surface layer, Cu sheet metal with a thickness of 0.20mm was used. The total thickness of a case (the shape of an anomaly (CFRP)) 11 is 0.83mm, and the thickness of CFRP Itabe 13 in the part which has a metallic thin plate 15 in a surface layer is 0.63mm.

[0036] As shown inside this case 11 at drawing 5 , the heating element (central processing unit) 14 has been arranged, the case 11 was put on the base 17 through SU **-SA, this heating element 14 was used, and extent of the temperature rise on the front face of an outside of a case 11 was investigated. Consequently, extent of the temperature rise on the front face of an outside of a case 11 was extent which carries out a temperature rise only to 46.5 degrees C, but touches by hand enough with the lower mid gear of a heating element 14 although it is the largest, and was small compared with extent of the temperature rise in the thermometry point 10 in the case of said example 2. This is because the heat sinking plane area when the heat received from the heating element 14 being spread to the metallic thin plate 15 of the case standing wall 16, and heat making the outside front face of the propagation case 11 a heat sinking plane for CFRP Itabe 13 further, and escaping to the exterior, since the metallic thin plate 15 is extended and formed to the standing wall 16 of a case 11 is large, so heat becomes easy to escape if heat release is large and lengthens.

[0037] Since it has always touched especially at the desk, the knee, etc. in the case of lower housing, if heat cannot escape from a front face easily compared with the part which touches on other open air enough like upper housing, therefore a metallic thin plate 15 is extended and formed to the standing wall 16 of a case 11 like the above-mentioned example 3, a heat dissipation property will be improved more and the temperature rise in a case outside front face will be controlled more effectively.

[0038] (Example 4) thickness [in said example 1]: -- the 0.3mm metallic thin plate made from pure aluminum -- replacing with -- a pure aluminum plate (thickness:0.2mm, width-of-face:100mm, and die-length:150mm) -- slit processing -- giving -- as an opening -- width-of-face:2mm, die-length: -- the scaling processing after crossing and arranging a 20mm slit -- giving -- a surface layer -- oh, the metallic thin plate carried out was used. Except for this point, it fabricated by the same approach as the case of an example 1, and the shape 5 of an anomaly CFRP concerning the example 4 which has the **** configuration shown in drawing 6 was acquired. In addition, the thickness of the monotonous section is the same as that of the case of an example 1. It is 0.9mm. Thus, when the acquired shape 5 (mold goods) of an anomaly CFRP was placed on Tokiwa, the spacer was hit from ****** and the amount of curvatures of mold goods was

measured, it was less than [amount:of curvatures1.0mm].

[0039] When the metallic thin plate which replaces with the metallic thin plate which has the above-mentioned slit for a comparison, and does not have a slit was used, the same shaping as the above was performed and measurement same about the obtained mold goods was carried out, the amount of curvatures was 3mm.

[0040] (Example 5) By law, the CFRP plate 7 (namely, compound plate) which allotted the metallic thin plates 8A and 8B made from following pure Cu or 8C to the surface layer was fabricated in the configuration like the case of said example 2 like what was shown in drawing 4 . In addition, as resin of CFRP, the fiber length:25mm thing was used as phenol resin and a carbon fiber. The dimension of a compound plate is width-of-face:100mm Die length: 140mm and CFRP Itabe's 7 thickness:0.7mm, Thickness of a metallic thin plate: It is 0.2mm.

Metallic-thin-plate-8-A-:-slit-less metallic-thin-plate 8B:width-of-face: -- 1mm, die-length: -- 10mm Those with a slit (10% of voidage)

Metallic-thin-plate 8C:width-of-face: -- 2mm, die-length: -- 20mm Those with a slit (10% of voidage)

[0041] The local heat test was performed by the approach same about the above-mentioned compound plate as the case of an example 2. In the case of the compound plate A which used metallic-thin-plate 8A as a metallic thin plate made from pure Cu, in the case of the compound plate B using 64.0 degrees C and metallic-thin-plate 8B, the maximum temperature in the thermometry point 10 the 1 same hour [as the case of an example 2] after heating initiation was 70.4 degrees C in the case of the compound plate C using 67.2 degrees C and metallic-thin-plate 8C. In addition, it was a thing in a CFRP simple substance (thickness of 0.9mm) because of the comparison, and when the same trial was performed, it was 95.7 degrees C.

[0042] Although a heat dissipation property falls a little by preparing ******, such as a slit, in the metallic thin plate formed in a CFRP surface layer from the above-mentioned examples 4 and 5, it turns out that the amount of curvatures of mold goods is mitigable.

[0043]

[Effect of the Invention] The anomaly-like fiber reinforced plastics (the shape of an anomaly (CFRP)) which this invention has the above configurations, acts and start this invention While having the mechanical property which was excellent conventionally like the shape of an anomaly CFRP (the shape of an anomaly (CFRP) given in JP,5-58371,B) Compared with the shape of an anomaly CFRP, excel in thermal conductivity conventionally, and the local temperature rise by local heating is small. Moreover, heat tends to escape, a carbon fiber cannot be seen further with the naked eye, and an appearance is good. Moreover, thickness : Even if it is the thing of thin meat 1mm or less, there is no boom hoisting in a front face, and shapeability and an appearance are good for it. Therefore, it can use suitable for the housing material of electronic equipment or an electrical machinery and apparatus etc. A device cannot become an elevated temperature easily and the dependability as a device improves, and if there are few local temperature rises of housing and they give and lengthen sense of security to a user, it can contribute to miniaturization and high-capacity-izing of electronic equipment etc., and the effectiveness that a fine sight may be improved is further done so. Moreover, according to the variant manufacture approach CFRP concerning this invention, the anomaly-like fiber reinforced plastics which do the starting outstanding operation effectiveness so can be manufactured now.

[Translation done.]

(19)日本国特許庁（ＪＰ）　(12)公開特許公報（Ａ）　(11)特許出願公開番号

特開平8－66989

(43)公開日　平成８年(1996)３月12日

(51)Int.Cl.[6]	識別記号	庁内整理番号	ＦＩ	技術表示箇所
Ｂ３２Ｂ 15/08	１０５	Ｚ 9349－4F		
Ｂ２９Ｃ 43/18		7365－4F		
Ｂ３２Ｂ 3/24		Ｚ 9349－4F		
5/02		Ｂ 9349－4F		
		Ｃ 9349－4F		

審査請求　未請求　請求項の数10　ＯＬ　（全８頁）　最終頁に続く

(21)出願番号　特願平7－147587

(22)出願日　平成７年(1995)６月14日

(31)優先権主張番号　特願平6－143325

(32)優先日　平６(1994)６月24日

(33)優先権主張国　日本（ＪＰ）

(71)出願人　000001199
株式会社神戸製鋼所
兵庫県神戸市中央区脇浜町１丁目３番18号

(72)発明者　杉野　守彦
兵庫県神戸市中央区脇浜町１丁目３番18号
株式会社神戸製鋼所神戸本社内

(72)発明者　田中　桂子
兵庫県神戸市中央区脇浜町１丁目３番18号
株式会社神戸製鋼所神戸本社内

(72)発明者　中川　知和
兵庫県神戸市西区高塚台１丁目５番５号
株式会社神戸製鋼所神戸総合技術研究所内

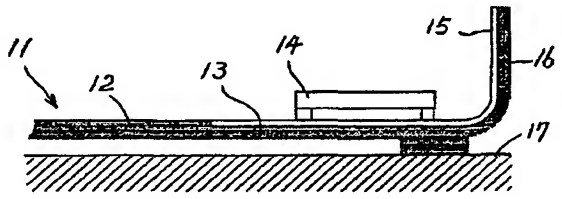
(74)代理人　弁理士　明田　尭

(54)【発明の名称】　異形状繊維強化プラスチック及びその製造方法

(57)【要約】

【目的】　機械的性質に優れ、且つ、熱伝導性に優れて局部的加熱による局部的温度上昇が小さく、又、熱が逃げ易く、更に、炭素繊維が肉眼で見えなくて外観が良く、又、厚さ：１mm以下の薄肉のものであっても表面に起伏がなくて形状性及び外観が良く、従って電子機器ハウジング材等に好適に用いることができる異形状繊維強化プラスチック（異形状CFRP）及びその製造方法を提供する。

【構成】　熱硬化性樹脂からなるマトリックス中に繊維長：10～100mm の炭素繊維が分布している薄肉の異形状CFRPであって、その表面層に金属薄板をプレス成形により一体に配しているもの、及び、異形状CFRPに成形すると共に、その表面層に金属薄板を一体に配することを特徴とする異形状CFRPの製造方法。



1

【特許請求の範囲】

【請求項１】　熱硬化性樹脂からなるマトリックス中に強化材として繊維長：10～100mm の炭素繊維が２次元的に且つ不規則的に分布している異形状繊維強化プラスチックであって、その表面層に金属薄板をプレス成形により一体に配していることを特徴とする異形状繊維強化プラスチック。

【請求項２】　前記金属薄板の厚みが 0.5mm以下である請求項１記載の異形状繊維強化プラスチック。

【請求項３】　前記金属薄板がAl、Al合金、Cu又はCu合金からなる請求項１又は２記載の異形状繊維強化プラスチック。

【請求項４】　前記金属薄板がスリット状の空隙を有し、その空隙の金属薄板に占める面積の割合である空隙率が50%以下である請求項１、２又は３記載の異形状繊維強化プラスチック。

【請求項５】　前記熱硬化性樹脂がフェノール樹脂：30 wt%以上を含有する熱硬化性樹脂である請求項１、２、３又は４記載の異形状繊維強化プラスチック。

【請求項６】　前記炭素繊維の繊維長が20～30mmである請求項１、２、３、４又は５記載の異形状繊維強化プラスチック。

【請求項７】　前記炭素繊維のマトリックスに対する体積比率が15～35%である請求項１、２、３、４、５又は６記載の異形状繊維強化プラスチック。

【請求項８】　平板部と凸状の異形形状部とを有する異形形状の一体成形体であって、該異形形状部の付け根における炭素繊維が、平板部と異形形状部とを繋ぐ方向に配向している請求項１、２、３、４、５、６又は７記載の異形状繊維強化プラスチック。

【請求項９】　引張強度：2450MPa 以上の炭素繊維からなる不織布に熱硬化性樹脂を含浸し乾燥してプリプレグを得、異形状のキャビティを有する成形型内に前記プリプレグ及び該プリプレグと接触する側の表面に樹脂を塗布した金属薄板を配置し、面圧：9.8MPa以上、温度：140 ～220 ℃で加熱加圧してプリプレグ中の熱硬化性樹脂と共に炭素繊維をキャビティ内で流動させ、異形状繊維強化プラスチックに成形すると共に、その表面層に金属薄板を一体に配することを特徴とする異形状繊維強化プラスチックの製造方法。

【請求項１０】　前記金属薄板に塗布する樹脂が、エポキシ樹脂である請求項９記載の異形状繊維強化プラスチックの製造方法。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、異形状繊維強化プラスチック及びその製造方法に関し、詳細には、熱硬化性樹脂からなるマトリックス中に強化材として炭素繊維を含有し、表面層に金属薄板を有する異形状繊維強化プラスチック及びその製造方法に関し、特に、CDプレーヤ、ヘッドホンステレオ、ノート型パソコン等の電子機器や電気機器等のハウジング材に用いて好適な異形状繊維強化プラスチック及びその製造方法に関する。

2

【０００２】

【従来の技術】電子機器や電気機器等のハウジング材としては金属のプレス加工品が用いられていたが、近年、加工性、軽量化等の観点から、ハウジング材のプラスチック化が進んでおり、これら機器のハウジング材として異形状繊維強化プラスチックが使用されつつある。特に、ノート型パソコン等のような携帯用電子機器においては、小型軽量化が強く要求されており、その一環としてハウジング材への異形状繊維強化プラスチックの適用が実用化されている。

【０００３】かかる異形状繊維強化プラスチック及びその製造方法として、特公平5-58371号公報に記載されたものが公知である。この公報に記載の異形状繊維強化プラスチック（以降、従来異形状CFRP-1という）は、熱硬化性樹脂からなるマトリックス中に強化材として繊維長：10～100mm の炭素繊維が２次元的に且つ不規則的に分布しており、平板部の厚さが１mm以下であることを特徴とするものである。そして、このような構成、特に繊維長：10～100mm の炭素繊維の２次元的且つ不規則的分布により、引張強度及び弾性率等の機械的性質が優れ且つ均一である。

【０００４】この公報に記載の異形状繊維強化プラスチックの製造方法は、引張強度：300kgf/mm^2 (:2942MPa) 以上の炭素繊維からなる不織布に熱硬化性樹脂を含浸し乾燥してプリプレグを得、このプリプレグを所定の異形状のキャビティを有する成形型内に配置し、面圧：100kgf/cm^2 (:9.8MPa) 以上で加熱加圧してプリプレグ中の熱硬化性樹脂と共に炭素繊維をキャビティ内で流動させ、異形状繊維強化プラスチックに成形することを特徴とするものである。そして、このような構成、特に熱硬化性樹脂と共に炭素繊維を流動させることにより、炭素繊維がマトリックス中に均一に分布し、引張強度及び弾性率等の機械的性質が均一で且つ優れた異形状繊維強化プラスチック（以降、従来異形状CFRP-2という）が得られる。

【０００５】

【発明が解決しようとする課題】前記従来異形状CFRP-1及び2によれば、前記の如く引張強度及び弾性率等の機械的性質が均一で且つ優れているので、電子機器や電気機器等のハウジング材の軽量化が図れ、引いては、その電子機器や電気機器等の軽量化が図れる。

【０００６】ところが、今後、これら電子機器や電気機器等のコンパクト化及び高容量化に伴い、その電子回路や電気回路（以下、電子回路）、電子部品や電気部品（以下、電子部品）からの発熱量が著しく増大し、且つ熱が逃げ難いため、機器自体が高温になって、電子部品の信頼性引いては機器としての信頼性が低下し、又、電

子部品からの熱によりハウジング（ケース）の温度が局部的に上昇して、直接身体に接すると低温火傷等の障害が発生する可能性があり、ユーザに不安感を与えるという問題点が生じるおそれがある。そのため、従来異形状CFRPでは、電子機器や電気機器等のコンパクト化及び高容量化が制限され、充分なコンパクト化及び高容量化が図れないというおそれがある。

【０００７】又、従来異形状CFRPでは、その表面及び表面近傍に存在する炭素繊維が肉眼で見えて外観が良くなく、又、厚さ：１㎜以下の薄肉のものでは、炭素繊維特有のうねりに起因して表面に起伏があり、形状性及び外観が良くないという問題点がある。

【０００８】本発明はこの様な事情に着目してなされたものであって、その目的は、前記した従来異形状CFRPの有する問題点を解消し、その優れた機械的性質を低下させることなく、熱伝導性に優れて局部的加熱による局部的温度上昇が小さく、又、熱が逃げ易く、更に、炭素繊維による表面のみだれが少なくて（炭素繊維が肉眼で見えなくて）外観が良く、又、厚さ：１㎜以下の薄肉のものであっても表面に起伏がなくて形状性及び外観が良い異形状繊維強化プラスチック及びその製造方法を提供しようとするものである。

【０００９】

【課題を解決するための手段】上記の目的を達成するために、本発明に係る異形状繊維強化プラスチック（以降、異形状CFRPという）及びその製造方法は次のような構成としている。即ち、請求項１記載の異形状CFRPは、熱硬化性樹脂からなるマトリックス中に強化材として繊維長：10～100㎜ の炭素繊維が２次元的に且つ不規則的に分布している異形状CFRPであって、その表面層に金属薄板をプレス成形により一体に配していることを特徴とする異形状CFRPである。

【００１０】請求項２記載の異形状CFRPは、前記金属薄板の厚みが 0.5㎜以下である請求項１記載の異形状CFRPである。請求項３記載の異形状CFRPは、前記金属薄板がAl、Al合金、Cu又はCu合金からなる請求項１又は２記載の異形状CFRPである。請求項４記載の異形状CFRPは、前記金属薄板がスリット状の空隙を有し、その空隙の金属薄板に占める面積の割合である空隙率が50％以下である請求項１、２又は３記載の異形状CFRPである。請求項５記載の異形状CFRPは、前記熱硬化性樹脂がフェノール樹脂：30wt％以上を含有する熱硬化性樹脂である請求項１、２、３又は４記載の異形状CFRPである。請求項６記載の異形状CFRPは、前記炭素繊維の繊維長が20～30㎜である請求項１、２、３、４又は５記載の異形状CFRPである。請求項７記載の異形状CFRPは、前記炭素繊維のマトリックスに対する体積比率が15～35％である請求項１、２、３、４、５又は６記載の異形状CFRPである。請求項８記載の異形状CFRPは、平板部と凸状の異形形状部とを有する異形形状の一体成形体であって、該異形形状部の付け根における炭素繊維が、平板部と異形形状部とを繋ぐ方向に配向している請求項１、２、３、４、５、６又は７記載の異形状CFRPである。

【００１１】請求項９記載の異形状CFRPの製造方法は、引張強度：2450MPa 以上の炭素繊維からなる不織布に熱硬化性樹脂を含浸し乾燥してプリプレグを得、異形状のキャビティを有する成形型内に前記プリプレグ及び該プリプレグと接触する側の表面に樹脂を塗布した金属薄板を配置し、面圧：9.8MPa以上、温度：140 ～220 ℃で加熱加圧してプリプレグ中の熱硬化性樹脂と共に炭素繊維をキャビティ内で流動させ、異形状CFRPに成形すると共に、その表面層に金属薄板を一体に配することを特徴とする異形状CFRPの製造方法である。請求項10記載の異形状CFRPの製造方法は、前記金属薄板に塗布する樹脂が、エポキシ樹脂である請求項９記載の異形状CFRPである。

【００１２】

【作用】本発明に係る異形状CFRP（異形状繊維強化プラスチック）は、前記の如く、熱硬化性樹脂からなるマトリックス中に強化材として繊維長：10～100㎜ の炭素繊維が２次元的に且つ不規則的に分布している異形状CFRPであって、その表面層に金属薄板をプレス成形により一体に配しており、従って、この金属薄板に起因して従来異形状CFRPよりも熱伝導性が向上して局部的加熱による局部的温度上昇が小さく、又、熱が逃げ易くなる。

【００１３】即ち、従来異形状CFRPにおいては、CFRPが金属に比較して著しく熱伝導性が劣る（熱伝導率が小さい）ので、局部的加熱を受けた場合、その熱がCFRP板の面方向に拡がり難く、そのため局部的加熱部の温度が上昇し易く、局部的温度上昇が大きくなり易い。又、その熱は局部的加熱部のCFRP板の板厚方向に伝わり、到達したCFRP板表面を放熱面として外部へ逃げるが、この放熱面の面積は局部的加熱部の面積と略同等であって小さいので、この放熱面からの放熱量が小さく、そのため極めて熱が逃げ難い。

【００１４】これに対し、本発明に係る異形状CFRPにおいては、前記の如く表面層に金属薄板を配しており、金属はCFRPに比較して著しく熱伝導性が優れている（熱伝導率が大きい）ので、局部的加熱を受けた場合、その熱が金属薄板の面方向に拡がり易く、そのため局部的加熱部の温度が上昇し難く、局部的温度上昇が小さくなり易い。そして、この金属薄板の面方向に拡散した熱は、異形状CFRP部に伝わり、到達したCFRP板表面を放熱面として外部へ逃げる。このとき、この放熱面の面積は金属薄板の表面積と略同等であって大きいので、この放熱面からの放熱量が大きく、そのため熱が逃げ易くなる。

【００１５】又、本発明に係る異形状CFRPにおいては、前記の如く表面層に金属薄板をプレス成形により一体に配しているので、厚さ：１㎜以下の薄肉のものであっても表面に起伏がなくて形状性及び外観が良い。即ち、従来異形状CFRPにおいてはマトリックスの熱硬化性樹脂と

炭素繊維との成形時の収縮率の差によって炭素繊維特有のうねりが生じるために表面に起伏を起こすが、本発明に係る異形状CFRPにおいては表面層の金属薄板により外観被覆されるために表面起伏が起こらなくなり、形状性及び外観が良いものとなる。

【００１６】更に、上記表面層の金属薄板により外観にCFRPが露出しなくなるために炭素繊維が肉眼で見えなくて外観が良い。

【００１７】同時に、本発明に係る異形状CFRPにおいては、上記金属薄板が配される基材であるCFRP部は、熱硬化性樹脂からなるマトリックス中に強化材として繊維長：10～100㎜ の炭素繊維が２次元的に且つ不規則的に分布したCFRPよりなり、このCFRPは従来異形状CFRP-1と同様であるので、従来異形状CFRP-1と同様に優れた機械的性質を有する。又、上記金属薄板は薄いので、かかる優れた機械的性質を損なう（低下させる）ものではない。

【００１８】従って、本発明に係る異形状CFRPは、従来異形状CFRPと同様に優れた機械的性質を有すると共に、従来異形状CFRPに比べ、熱伝導性に優れて局部的加熱による局部的温度上昇が小さく、又、熱が逃げ易く、更に、炭素繊維が肉眼で見えなくて外観が良く、又、厚さ：１㎜以下の薄肉のものであっても表面に起伏がなくて形状性及び外観が良い。

【００１９】ここで、炭素繊維の繊維長を10～100㎜ としているのは、10㎜未満では炭素繊維同士の絡みが少なくなり、部分的に炭素繊維の含有量が少ない個所が存在するため、強度及び弾性率が低下して不充分となり、一方100㎜ 超では炭素繊維がカール状となるため、強度及び弾性率が低下して不充分となるからである。尚、かかる点から炭素繊維の繊維長は20～30㎜にすることが望ましく、そうすると確実に高度の強度及び弾性率を確保し得てよい（請求項６記載の異形状CFRP）。

【００２０】前記金属薄板としては、軽量化の点から比重が小さく、又、加工性が良好であるものが好ましく、かかる点からAl、Al合金、Cu又はCu合金からなるものが望ましい（請求項３記載の異形状CFRP）。これら金属薄板表面にアルマイト処理、めっき、塗装等の表面処理を施してもよい。

【００２１】前記金属薄板の厚みとしては、 0.5㎜以下とすることが望ましい（請求項２記載の異形状CFRP）。金属薄板の厚みを 0.5㎜超にすると、CFRP部の厚みが相対的に薄くなるために強度の低下及び軽量性の低下を来して好ましくなく、 0.5㎜以下では高水準の強度及び軽量性を有することができるからである。尚、金属薄板を以上の如くCFRP表面層に設けることに加えて、金属薄板をCFRPの内部にも設けることができ、その場合には成形性が低下するが、更に放熱特性が向上する。

【００２２】前記金属薄板がスリット状の空隙を有し、その空隙の金属薄板に占める面積の割合である空隙率が50％以下であるようにすることが望ましい（請求項４記載の異形状CFRP）。このようにすると、金属薄板とCFRP部との線膨張係数の相違による反りの発生を抑制できるようになるからである。即ち、金属の種類及びCFRPの種類によって異なるが、通常、金属とCFRPとは線膨張係数が比較的大幅に相違するので、金属薄板が空隙を有していない場合には、製造（成形）の際の加熱後の冷却過程における金属薄板とCFRP部との収縮量が相違し、その結果、製造後のもの（成形品）に反りが発生する可能性があり、又、成形品使用の際に受ける熱によっても成形品に反りが発生する可能性がある。これに対し、金属薄板がスリット状の空隙を有している場合には、金属とCFRPとは線膨張係数が相違するものの、製造（成形）の際の加熱後の冷却過程における金属薄板とCFRP部との収縮量があまり相違せず、同等となるか、もしくは近似し、その結果、上記の如き反りが発生し難くなり、発生したとしても極めて微量の反りにとどめることができる。このとき、空隙率が大きいほど反りの程度を小さくできるが、それに伴って放熱特性が少しずつ低くなる傾向にあり、空隙率50％超では放熱特性が比較的大きく低下するので、空隙率は50％以下にするのがよい。又、空隙の総面積についても、放熱特性に対して上記空隙率と同様の影響を及ぼし、空隙の総面積500㎟超では放熱特性が比較的大きく低下するので、500㎟以下にするのがよい。

【００２３】前記熱硬化性樹脂としては、例えばフェノール樹脂、エポキシ樹脂、ポリイミド樹脂、及び、これらの混合物があるが、特にはフェノール樹脂：30wt％以上を含有する熱硬化性樹脂とすることが望ましい（請求項５記載の異形状CFRP）。それは、異形状CFRPは曲げ強度：147MPa以上、曲げ弾性率：12 GPa以上、アイゾット衝撃値：98Ｊ／ｍ（：10kgfcm/cm²）以上の機械的物性を有し、又、難燃性に優れていることが望ましく、これらの特性を充たすことができるからである。

【００２４】前記炭素繊維のマトリックスに対する体積比率を15～35％にすることが望ましい。そうすると確実に高度の強度及び弾性率を確保し得てよい（請求項７記載の異形状CFRP）。この体積比率を15％未満にすると強度及び弾性率が低下し、35％超にするとマトリックスの樹脂となじまない部分が生じて強度が低下する傾向にある。

【００２５】本発明に係る異形状CFRPが平板部と凸状の異形形状部とを有する場合、該異形形状部の付け根における炭素繊維が、平板部と異形形状部とを繋ぐ方向に配向していることが望ましい（請求項８記載の異形状CFRP）。そうすると該異形形状部は強度に優れ、平板部との強度差が小さくなるからである。

【００２６】本発明に係る異形状CFRPの製造方法は、前述の如く、引張強度：2450MPa 以上の炭素繊維からなる不織布に熱硬化性樹脂を含浸し乾燥してプリプレグを得、異形状のキャビティを有する成形型内に前記プリプ

レグ及び該プリプレグと接触する側の表面に樹脂を塗布した金属薄板を配置し、面圧：9.8MPa以上、温度：140～220 ℃で加熱加圧してプリプレグ中の熱硬化性樹脂と共に炭素繊維をキャビティ内で流動させ、異形状CFRPに成形すると共に、その表面層に金属薄板を一体に配するようにしている。従って、従来異形状CFRP-2の場合と同様もしくはそれ以上に炭素繊維がマトリックス中に均一に分布し、引張強度及び弾性率等の機械的性質に優れ且つその均一性に優れた異形状CFRPであって、同時に、表面層に金属薄板を配してなる異形状CFRPを製造し得る。そのため、従来異形状CFRP-2の場合と同様もしくはそれ以上に機械的性質に優れ且つその均一性に優れると共に、上記表面層の金属薄板に起因して従来異形状CFRPよりも熱伝導性に優れて局部的加熱による局部的温度上昇が小さく、又、熱が逃げ易く、更に、炭素繊維が肉眼で見えなくて外観が良く、又、厚さ：１㎜以下の薄肉のものであっても表面に起伏がなくて形状性及び外観が良い異形状CFRPが得られる。

【００２７】ここで、炭素繊維の引張強度を2450MPa 以上としているのは、異形状CFRPの引張強度を49MPa 以上に充分高くするためである。成形型内にプリプレグ及び金属薄板を配置するに際し、金属薄板のプリプレグと接触する側の表面（金属薄板表面）に樹脂を塗布するようにしているのは、成形後の異形状CFRPでの金属薄板と基材のCFRPとの密着性を高め、充分なものとするためである。

【００２８】成形の際の成形圧を面圧で9.8MPa以上としているのは、9.8MPa未満にすると熱硬化性樹脂と共に炭素繊維が流動することが困難になり、マトリックス中での炭素繊維分布の均一性が低下し、機械的性質が不均質になるからである。又、成形温度を140 ～220 ℃としているのは、140 ℃未満にすると硬化時間に10分以上必要とするようになり、所要硬化時間が長くなり過ぎ、引いては成形品の生産性が低くなって不充分となり、220 ℃超にすると硬化時間が短くなり過ぎ、そのため成形（ふ形）が困難になるからである。

【００２９】前記金属薄板に塗布する樹脂としては、エポキシ樹脂を使用することが望ましい（請求項10記載の異形状CFRPの製造方法）。そうすると、金属薄板と基材のCFRPとの密着性をより高めることができるからである。又、金属薄板とともに配置するプリプレグは積層して配置し、そして成形するようにすると、炭素繊維の方向性が緩和され、成形品の強度をより均一にし得る。

【００３０】

【実施例】

（実施例１）先ず、引張強度：2942MPa 、繊維長：25mmの炭素繊維からなる不織布にフェノール樹脂（熱硬化性樹脂の一種）を含浸し乾燥機により120 ℃で10分間加熱乾燥してプリプレグ（厚さ:1.0mm）を得た。一方、純Alよりなる厚み:0.3mmの金属薄板の上面（後記プリプレグ２と接触する側の面）にエポキシ樹脂を塗布した。次に、図１に示す如く、下型４内に前記金属薄板３を配置し、この上に前記プリプレグ２を５枚積層して配置した後、図２に示す如く、上型１を閉じ、成形圧（面圧）：39MPa 、温度:150℃の成形条件で加圧して異形状CFRPに成形すると共に、その表面層に金属薄板を一体に配した。そして、図３に示す如き形状を有する実施例１に係る異形状CFRP５を得た。尚、この異形状CFRP５の平板部の厚さ（金属薄板とCFRP部との合計厚み）は 0.9㎜である。CFRPのマトリックスの樹脂に対する炭素繊維の体積率は25％である。図３において６はボス部を示すものである。

【００３１】この実施例１に係る異形状CFRP５について、クリア塗装を行い、目視検査を行った後、局部的加熱試験を行った。又、曲げ試験片及びアイゾット衝撃試験片を採取し、曲げ試験及び衝撃試験を行った。ここで、局部的加熱試験は、異形状CFRP５がハウジングとして使用された場合に電子部品からの熱により局部的に加熱される状態を模擬して局部的に加熱し、そのときの異形状CFRP５の表面（加熱される側の面と反対側の面）の温度を測定することにより行った。その結果、表面に炭素繊維が肉眼で見えなくて外観が良く、更に、表面に起伏がなくて形状性及び外観が良かった。アイゾット衝撃値は291 J/m 、曲げ弾性率は16GPa 、曲げ強度は246MPaであり、下記比較例１と同様に優れた機械的性質を有していた。局部的加熱試験による異形状CFRP５の表面の最高到達温度は60℃であり、下記比較例１の場合に比して著しく低かった。

【００３２】比較のため、上記実施例１と同様のプリプレグを用い、金属薄板３を配置せずに、上記実施例１と同様の条件で同様の方法により成形して比較例１に係る異形状CFRPを得、このCFRPについて上記実施例１と同様の検査、試験を行った。その結果、表面に炭素繊維が目視で見え、更に、表面起伏（うねり）が認められた。尚、このうねりはクリア塗装後の方が塗装前よりも顕著であった。アイゾット衝撃値は250 J/m 、曲げ弾性率は15GPa 、曲げ強度は240MPaであった。局部的加熱試験による表面の最高到達温度は95℃であり、極めて高かった。

【００３３】（実施例２）本発明に係る異形状CFRPでの金属薄板としてCu薄板を使用した場合の局部的加熱による局部的温度上昇抑制効果についての基本的データを得るため、図４に示す如く、表面層に純Cu製金属薄板８を配したCFRP板７（即ち、CFRP板７の表面層に純Cu製金属薄板８を配した複合板）をプレス成形により成形し、これについて局部的加熱試験を行った。ここで、CFRPのマトリックスの樹脂としてはフェノール樹脂を用い、強化材の炭素繊維としては繊維長：30mmのものを用いた。複合板の寸法は、幅90mm、長さ140mm 、総厚さ0.83mmであり、そのCFRP板部７の厚さは0.63mm、純Cu製金属薄板８の厚さは0.2mm である。局部的加熱試験は、図４に示す

如く、4.81Wの正方形板形状（辺長48mm）の発熱体９を加熱源として、Ｃ系樹脂製スペーサを介して複合板の上（純Cu製金属薄板８の上）に置き、一方CC（銅・コンスタンタン）熱電対を複合板の下側（CFRP板７の表面）の温度測定点10に貼付け、これらを紙箱（図示していない）で被った後、発熱体９に通電して複合板を加熱すると共に温度測定点10での温度を測定することにより行った。

【００３４】上記加熱開始１時間後における温度測定点10（即ち、複合板において発熱体９がある側と反対の側の表面）での最高温度は、64.2℃であった。又、比較のために、上記複合板に代えて、上記複合板と同一寸法のMg合金板、或いはCFRP単体の板（CFRP板のみよりなる）を用い、上記と同様の方法により同様の局部的加熱試験を行ったところ、加熱開始１時間後の温度測定点10での最高温度は、Mg合金板の場合で62.0℃、CFRP単体の板の場合で95.7℃であった。これらのことから、CFRP単体ではMg合金板に比べて局部的上昇最高温度が30℃以上高いが、CFRPの表面層に純Cu製金属薄板を配して複合化すると局部的上昇最高温度がMg合金板のそれと同等になり、放熱特性がCFRP単体に比べて大幅に改善されることがわかる。

【００３５】（実施例３）本発明に係る異形状CFRPよりなるノート型パソコンの下部ケースを作った。この下部ケースの要部を図５に示す。ここで、CFRP12，13のマトリックスの樹脂としてはフェノール樹脂を用い、強化材の炭素繊維としては繊維長：30mmのものを用いた。表面層の金属薄板15としては厚さ0.20mmのCu薄板を用いた。ケース（異形状CFRP）11の総厚さは0.83mmであり、表面層に金属薄板15がある個所でのCFRP板部13の厚さは0.63mmである。

【００３６】このケース11の内側に図５に示す如く発熱体（中央演算装置）14を配置し、ケース11をスペーサを介して台17の上に乗せ、該発熱体14を働かせ、ケース11の外側表面の温度上昇の程度を調べた。その結果、ケース11の外側表面での温度上昇の程度は、発熱体14の下部中央位置で最も大きいが、46.5℃までしか温度上昇せず、充分手で触れる程度であり、前記実施例２の場合の温度測定点10での温度上昇の程度に比べて小さかった。これは、金属薄板15をケース11の立壁16まで延長して設けているため、発熱体14から受けた熱がケース立壁16の金属薄板15まで拡散し、更に熱がCFRP板部13を伝わりケース11の外側表面を放熱面として外部へ逃げるときの放熱面面積が大きいために放熱量が大きく、引いては熱が逃げ易くなったからである。

【００３７】特に、下部ケースの場合には常に机や膝等に接しているので、上部ケースの如く他の外気に充分触れる部分に比べて表面から熱が逃げ難く、そのため上記実施例３の如く金属薄板15をケース11の立壁16まで延長して設けると、より放熱特性を向上し、ケース外側表面での温度上昇がより効果的に抑制される。

【００３８】（実施例４）前記実施例１での厚み:0.3mmの純Al製金属薄板に代えて、厚み:0.2mm，幅:100mm，長さ:150mmの純Al板にスリット加工を施し、空隙として幅:2mm，長さ:20mmのスリットを交差して配置させた後、表面酸化処理を施して表面層をあらした金属薄板を使用した。かかる点を除き、実施例１の場合と同様の方法により成形を行い、図６に示す如き形状を有する実施例４に係る異形状CFRP５を得た。尚、平板部の厚さは実施例１の場合と同様の 0.9mmである。このようにして得られた異形状CFRP５（成形品）を常盤上に置き、四隅みよりスペーサーをあてて成形品の反り量を測定したところ、反り量:1.0mm以下であった。

【００３９】比較のため、上記スリットを有する金属薄板に代えてスリットの無い金属薄板を使用し、上記と同様の成形を行い、得られた成形品について同様の測定をしたところ、反り量は３mmであった。

【００４０】（実施例５）前記実施例２の場合と同様法により、図４に示したものと同様形状で、表面層に下記純Cu製金属薄板8A，8B又は8Cを配したCFRP板７（即ち、複合板）を成形した。尚、CFRPの樹脂としてはフェノール樹脂、炭素繊維としては繊維長：25mmのものを用いた。複合板の寸法は、幅:100mm，長さ:140mm，CFRP板部７の厚さ:0.7mm，金属薄板の厚さ:0.2mmである。

金属薄板8A：スリット無し

金属薄板8B：幅:1mm，長さ:10mm のスリット有り（空隙率10%）

金属薄板8C：幅:2mm，長さ:20mm のスリット有り（空隙率10%）

【００４１】上記複合板について実施例２の場合と同様の方法により局部的加熱試験を行った。実施例２の場合と同様の加熱開始１時間後における温度測定点10での最高温度は、純Cu製金属薄板として金属薄板8Aを用いた複合板Ａの場合で64.0℃、金属薄板8Bを用いた複合板Ｂの場合で67.2℃、金属薄板8Cを用いた複合板Ｃの場合で70.4℃であった。尚、比較のためCFRP単体（厚み0.9mm）でのもので同様の試験を行ったところ、95.7℃であった。

【００４２】上記実施例４及び５から、CFRP表面層に設ける金属薄板にスリット等の空隙をを設けることにより、若干放熱特性が低下するものの、成形品の反り量を軽減できることがわかる。

【００４３】

【発明の効果】本発明は以上のような構成を有し作用をなすものであり、本発明に係る異形状繊維強化プラスチック（異形状CFRP）は、従来異形状CFRP（特公平5-58371 号公報に記載の異形状CFRP）と同様に優れた機械的性質を有すると共に、従来異形状CFRPに比べ、熱伝導性に優れて局部的加熱による局部的温度上昇が小さく、又、熱が逃げ易く、更に、炭素繊維が肉眼で見えなくて外観

11

が良く、又、厚さ：１㎜以下の薄肉のものであっても表面に起伏がなくて形状性及び外観が良く、従って、電子機器や電気機器のハウジング材等に好適に用いることができ、機器が高温になり難くて機器としての信頼性が向上し、又、ハウジングの局部的温度上昇が少なくてユーザに安心感を与えられ、引いては電子機器等のコンパクト化及び高容量化に寄与し得、更に、美観を向上し得るという効果を奏する。又、本発明に係る異形状CFRPの製造方法によれば、かかる優れた作用効果を奏する異形状繊維強化プラスチックを製造し得るようになる。

【図面の簡単な説明】

【図１】　実施例１に係る成形型への異形状繊維強化プラスチック（CFRP）成形用材料の配置状況の概要を示す側断面図である。

【図２】　実施例１に係る異形状CFRPの成形状況の概要を示す側断面図である。

【図３】　実施例１に係る異形状CFRP成形品の概要を示す斜視図であり、図３(A)は成形品の外側を示す図、図３(B)は成形品の内側を示す図である。

12

【図４】　実施例２に係る成形品の局部的加熱試験状況の概要を示す側断面図である。

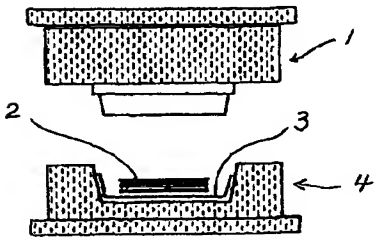
【図５】　実施例３に係る異形状CFRPよりなるノート型パソコン下部ケースについての局部的加熱試験の概要を示す側断面図である。

【図６】　実施例４に係る異形状CFRP成形品の概要を示す斜視図であり、図６(A)は成形品の外側を示す図、図６(B)は成形品の内側を示す図である。

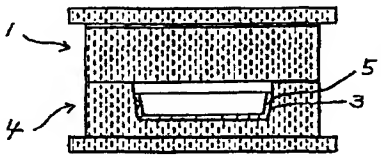
【符号の説明】

１--上型、２--プリプレグ、３--金属薄板、４--下型、５--異形状CFRP、６--ボス部、７--CFRP板、８--純Cu製金属薄板、９--発熱体、10--温度測定点、11--ケース、12--CFRP、13--CFRP、14--発熱体、15--金属薄板、16--ケースの立壁、17--台。

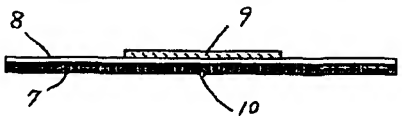
【図１】



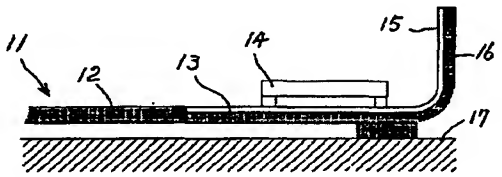
【図２】



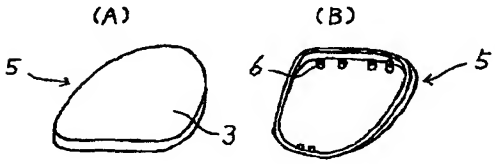
【図４】



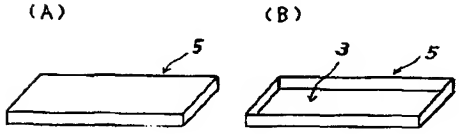
【図５】



【図３】



【図６】



フロントページの続き

(51)Int.Cl.[6]		識別記号	庁内整理番号	FI	技術表示箇所
B32B	27/42	101	9349－4F		
// B29K	105:08				
	105:22				
B29L	9:00				